

## IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant	:	F. Farassat	)	Group Art Unit Unknown
			)	
Appl. No.	:	Unknown	)	
			)	
Filed	:	Herewith	)	
			)	
For	:	METHOD OF TESTING	)	
		BONDED CONNECTIONS,	)	
		AND A WIRE BONDER	)	
			)	
Examiner	:	Unknown	)	

PRELIMINARY AMENDMENT

Assistant Commissioner for Patents  
Washington, D.C. 20231

Dear Sir:

Prior to examination, please amend the above referenced application as follows:

**IN THE SPECIFICATION:**

Page 1, line 8, immediately after the title, please insert:

Related Applications

This application claims the benefit of the European application 01 126 621.0 filed November 7, 2001.

Please amend the paragraph beginning on page 1, line 10, as follows:

Background of the InventionField of the Invention

The invention relates to a method of testing bonded connections and to a wire bonder equipped with a corresponding, integrated testing arrangement.

Description of the Related Art

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Please amend the paragraph beginning on page 3, line 22, as follows:

#### Summary of the Invention

It is the objective of the invention to disclose a method of testing bonded connections that is directly integrated into the manufacturing process, as well as a wire bonder suitable for implementing this method, which enables real-time quality control and the immediate execution of quality-ensuring adjustment procedures while the bonding process is still under way.

Please amend the paragraph beginning on page 3, line 29, as follows:

The objective is achieved with respect to a method of testing wire-bond connections between a bonding wire and a separate surface, in particular a bonding pad, which are produced by a bonding head with a bonding tool and a wire clamp associated with the bonding tool, wherein the wire-bond connections are produced under pressure, ultrasound, or heat. In one embodiment, the method comprises lifting the bonding head or the bonding tool a short distance away from the bonding site after the bonded connection has been created, fixedly gripping the bonding wire with the wire clamp, and raising the bonding head or the wire clamp with bonding wire gripped therein for a second distance during which process the tensile force acting on the bonding wire is detected.

In one aspect, raising the bonding head or the wire clamp for the second distance is calculated, in dependence on the structural features, so that a predetermined tensile force is exerted as a result of the raising, and an intact state of the bonded connection is detected during raising. In addition, the intactness of the bonded connection is determined by observing the time course of the tensile force acting on the wire clamp during the raising.

In one embodiment, a wire bonder in which there is integrated into a bonding head a testing arrangement for wire-bond connections between a bonding wire and a separate surface. Additionally, the bonding head comprises a tool or transducer holder to hold a bonding tool and a wire-clamp holder to hold a wire clamp for gripping a bonding wire, as well as a drive mechanism for the vertical displacement of the bonding head or tool holder and wire-clamp holder, and wherein a program control system to control a predetermined movement sequence of the bonding head or tool holder and wire-clamp holder is associated with the drive mechanism in

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order to carry out a measurement of tensile force at the bonding wire, and a force measuring device is associated with the wire-clamp holder in order to measure a tensile force acting on a bonded connection to the bonding wire that has been produced.

In one aspect, the wire-clamp holder is mounted on the bonding head so that it can be elastically deflected or linearly displaced against the action of a pretensioning element, and a force-measurement element or a strain gauge is associated with the holder. Additionally, the wire-clamp holder comprises a weakened preferential bending section or leaf-spring section, which ensures the elastic deflectability and in which the strain gauge is located. Furthermore, the program control system comprises a control program for automatically carrying out the method.

Please amend the paragraph beginning on page 4, line 1, follows:

The invention includes the idea of exposing a bonded connection to a tensile force immediately after it has been created, and of detecting its response. It further includes the idea that for this purpose the bonding tool and a wire clamp to grip the bonding wire should be moved in a suitable sequence of steps, in combination with a step in which the tensile force is measured, and the idea of disclosing a corresponding arrangement of a tool holder and a wire-clamp holder in combination with a control and evaluation means adapted thereto. One characteristic of the execution of the procedure is that the bonding wire is firmly gripped and pulled as soon as the bonded connection has been created (but after the contact between the bonded connection and the bonding tool has been broken), during simultaneous measurement of the tensile force.

Please amend the paragraph beginning on page 4, line 30, as follows:

A testing arrangement suitable for implementing the proposed solution comprises the wire-clamp holder provided with an associated force-measuring element and a control device to control the movement pattern sketched out above, and represents an integrated component of an improved wire bonder.

Please amend the paragraph beginning on Page 5, line 18, as follows:

#### Brief Description of the Drawings

Figure 1 illustrates a schematic drawing of one embodiment of a testing arrangement.

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Detailed Description of the Preferred Embodiment

Other advantages and useful features of the invention will be apparent from the subordinate claims and from the following description of a preferred exemplary embodiment with reference to Figure 1. This shows, in a schematic drawing, a testing arrangement 1 with components of the bonding head 3 of an ultrasonic wire bonder constructed in accordance with the invention. The elementary diagram refers to a bonding head of the kind described in the patent EP 0 857 535 A1, the structural details of which are not shown here. In the nature of a synoptic representation, function blocks are added with evaluation and control functions and symbols for the procedural steps.

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**IN THE CLAIMS:**

Please amend the Claims as follows:

**WHAT IS CLAIMED IS:**

1. (Amended) A method of testing wire-bond connections between a bonding wire and a separate surface, the connections being produced by a bonding head with a bonding tool and a wire clamp associated with the bonding tool under pressure and the action of at least one of ultrasound and heat, the method comprising:

lifting the bonding head or the bonding tool a first distance away from the bonding site after the bonded connection has been created;

fixedly gripping the bonding wire with the wire clamp; and

raising the bonding head or the wire clamp with bonding wire gripped therein for a second distance during which process the tensile force acting on the bonding wire is detected.

2. (Amended) The method of Claim 1, wherein raising the bonding head or the wire clamp for the second distance is calculated, in dependence on the structural features, so that a predetermined tensile force is exerted as a result of the raising, and an intact state of the bonded connection is detected during raising.

3. (Amended) The method of Claim 2, wherein the intactness of the bonded connection is determined by observing the time course of the tensile force acting on the wire clamp during the raising.

4. (Amended) A wire bonder in which there is integrated into a bonding head a testing arrangement for wire-bond connections between a bonding wire and a separate surface.

5. (Amended) The wire bonder of Claim 4, wherein the bonding head comprises a tool holder or transducer holder to hold a bonding tool and a wire-clamp holder to hold a wire clamp for gripping the bonding wire, as well as a drive mechanism for vertical displacement of the bonding head or tool holder and wire-clamp holder, and wherein a program control system to control a predetermined movement sequence of the bonding head or tool holder and the wire-

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clamp holder is associated with the drive mechanism in order to carry out a measurement of tensile force at the bonding wire, and wherein a force measuring device is associated with the wire-clamp holder in order to measure a tensile force acting on a bonded connection to the bonding wire that has been produced.

6. (Amended) The wire bonder of Claim 5, wherein the wire-clamp holder is mounted on the bonding head so that it can be elastically deflected against the action of a pretensioning element and a force-measurement element is associated with the holder.

7. (Amended) The wire bonder of Claim 6, wherein the wire-clamp holder comprises a weakened preferential bending section or leaf-spring section, which ensures the elastic deflectability and in which the force-measurement element is located.

8. (Amended) The wire bonder of Claim 5, wherein the program control system induces the bonding head to lift a first distance and induces the wire clamp to grip the bonding wire and then induces the bonding head or the wire clamp to raise a second distance while the force measuring device measures the tensile force acting on the bonding wire.

Please, add the following new Claims:

9. (New) The wire bonder of Claim 4, wherein the separate surface is a bonding pad.

10. (New) The wire bonder of Claim 5, wherein the wire-clamp holder is mounted on the bonding head so that it can be linearly displaced.

11. (New) The wire bonder of Claim 6, wherein the force-measurement element comprises a strain gauge.

12. (New) A method of testing wire-bonded connections between a bonding wire and a separate surface having a bonding site, the method comprising:

lifting a bonding tool a first distance away from the bonding site after the bonded connection has been created;

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fixedly gripping the bonding wire with a wire clamp; and  
raising the bonding tool for a second distance during which process the tensile force acting on the bonding wire is detected.

13. (New) The method of Claim 12, wherein the method further comprises producing the wire connections with a bonding head, a bonding tool, and a wire clamp associated with the bonding tool.

14. (New) The method of Claim 13, wherein producing the wire-bond connections includes producing the wire connections under pressure, ultrasound, or heat.

15. (New) The method of Claim 12, wherein lifting a bonding tool comprises lifting a bonding head.

16. (New) The method of Claim 12, wherein raising the bonding tool comprises raising the wire clamp with bonding wire gripped therein.

17. (New) The method of Claim 12, wherein lifting the bonding tool a first distance includes lifting the bonding tool a short distance.

18. (New) The method of Claim 12, wherein raising the bonding head or the wire clamp for the second distance is calculated in a manner so as to be dependent on the structural features so that a predetermined tensile force is exerted as a result of the raising.

19. (New) The method of Claim 18, wherein an intact state of the bonded connection is detected during raising.

20. (New) The method of Claim 19, wherein the intactness of the bonded connection is determined by observing the time course of the tensile force acting on the wire clamp during the raising.

21. (New) A wire bonder device comprising a bonding head with an integrated testing arrangement for wire-bond connections between a bonding wire and a surface.

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22. (New) The device of Claim 21, wherein the bonding head comprises a holding tool to hold a bonding tool and a wire-clamp holder to hold a wire clamp for gripping a bonding wire.

23. (New) The device of Claim 22, wherein the holding tool comprises a transducer holder.

24. (New) The device of Claim 22, wherein the bonding head further comprises a drive mechanism for the vertical displacement of the bonding head and wire-clamp holder.

25. (New) The device of Claim 24, wherein the bonding head further comprises a program control system to control a predetermined movement sequence of the bonding head and wire-clamp holder.

26. (New) The device of Claim 25, wherein the program control system is associated with the drive mechanism and carries out a measurement of tensile force at the bonding wire, and a force measuring device is associated with the wire-clamp holder in order to measure a tensile force acting on a bonded connection to the bonding wire that has been produced.

27. (New) The device of Claim 26, wherein the wire-clamp holder is mounted on the bonding head so that it can be elastically deflected against the action of a pre-tensioning element, and a force-measurement element or a strain gauge is associated with the holder.

28. (New) The device of Claim 27, wherein the wire-clamp holder comprises a weakened preferential bending section or leaf-spring section, which ensures the elastic deflectability and in which the strain gauge is located.

29. (New) The device of Claim 21, wherein the surface includes a separate surface.

30. (New) The device of Claim 29, wherein the separate surface includes a bonding pad.



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**IN THE ABSTRACT:**

Please amend the abstract as follows:

Abstract of the Disclosure

A method of testing wire-bond connections between a bonding wire and a substrate surface. The wire-bond connections are produced by a bonding head with a bonding tool and a wire clamp associated with the bonding tool under pressure and the action of ultrasound and/or heat. After the bonded connection has been created, the bonding head or the bonding tool is raised a short distance away from the bonding site, the bonding wire is firmly gripped by the wire clamp and the bonding head. The wire clamp with bonding wire gripped therein is raised for a second distance, during which process the tensile force acting on the bonding wire is detected.

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**REMARKS**

These changes are being made to bring the subject application into better conformance with U.S. practice, to claim the benefit of a previously filed European application, and to more distinctly claim what the Applicants regard as the invention. No new matter is being introduced. Entrance of this amendment is respectfully requested.

Attached hereto is a marked-up version of the changes made to the application by the current amendment. The attached page is captioned "**Version with Markings to Show Changes Made**"; additions are shown as underlined and deletions are shown [bracketed].

Please charge any additional fees, including any fees for additional extension of time, or credit overpayment to Deposit Account No. 11-1410.

Respectfully submitted,

KNOBBE, MARTENS, OLSON & BEAR, LLP

Dated: \_\_\_\_\_

2/27/02

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**Version with Markings to Show Changes Made**

**IN THE SPECIFICATION:**

Page 1, line 8, immediately after the title, please insert:

Related Applications

This application claims the benefit of the European application 01 126 621.0 filed November 7, 2001.

Please amend the paragraph beginning on page 1, line 10, as follows:

[DESCRIPTION]

Background of the Invention

Field of the Invention

The invention relates to a method of testing bonded connections and to a wire bonder equipped with a corresponding, integrated testing arrangement.

Description of the Related Art

Please amend the paragraph beginning on page 3, line 22, as follows:

Summary of the Invention

It is the objective of the invention to disclose a method of testing bonded connections that is directly integrated into the manufacturing process, as well as a wire bonder suitable for implementing this method, which enables real-time quality control and the immediate execution of quality-ensuring adjustment procedures while the bonding process is still under way.

Please amend the paragraph beginning on page 3, line 29, as follows:

[This objective is achieved with respect to the method by a testing procedure with the characteristics given in Claim 1, and with respect to the apparatus by a wire bonder with the characteristics given in Claim 4.]

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The objective is achieved with respect to a method of testing wire-bond connections between a bonding wire and a separate surface, in particular a bonding pad, which are produced by a bonding head with a bonding tool and a wire clamp associated with the bonding tool, wherein the wire-bond connections are produced under pressure, ultrasound, or heat. In one embodiment, the method comprises lifting the bonding head or the bonding tool a short distance away from the bonding site after the bonded connection has been created, fixedly gripping the bonding wire with the wire clamp, and raising the bonding head or the wire clamp with bonding wire gripped therein for a second distance during which process the tensile force acting on the bonding wire is detected.

In one aspect, raising the bonding head or the wire clamp for the second distance is calculated, in dependence on the structural features, so that a predetermined tensile force is exerted as a result of the raising, and an intact state of the bonded connection is detected during raising. In addition, the intactness of the bonded connection is determined by observing the time course of the tensile force acting on the wire clamp during the raising.

In one embodiment, a wire bonder in which there is integrated into a bonding head a testing arrangement for wire-bond connections between a bonding wire and a separate surface. Additionally, the bonding head comprises a tool or transducer holder to hold a bonding tool and a wire-clamp holder to hold a wire clamp for gripping a bonding wire, as well as a drive mechanism for the vertical displacement of the bonding head or tool holder and wire-clamp holder, and wherein a program control system to control a predetermined movement sequence of the bonding head or tool holder and wire-clamp holder is associated with the drive mechanism in order to carry out a measurement of tensile force at the bonding wire, and a force measuring device is associated with the wire-clamp holder in order to measure a tensile force acting on a bonded connection to the bonding wire that has been produced.

In one aspect, the wire-clamp holder is mounted on the bonding head so that it can be elastically deflected or linearly displaced against the action of a pretensioning element, and a force-measurement element or a strain gauge is associated with the holder. Additionally, the wire-clamp holder comprises a weakened preferential bending section or leaf-spring section, which ensures the elastic deflectability and in which the strain gauge is located. Furthermore, the program control system comprises a control program for automatically carrying out the method.

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Please amend the paragraph beginning on page 4, line 1, as follows:

The invention includes the [essential] idea of exposing a bonded connection to a tensile force immediately after it has been created, and of detecting its response. It further includes the idea that for this purpose the bonding tool and a wire clamp to grip the bonding wire should be moved in a suitable sequence of steps, in combination with a step in which the tensile force is measured, and the idea of disclosing a corresponding arrangement of a tool holder and a wire-clamp holder in combination with a control and evaluation means adapted thereto. [An essential] One characteristic of the execution of the procedure is that the bonding wire is firmly gripped and pulled as soon as the bonded connection has been created (but after the contact between the bonded connection and the bonding tool has been broken), during simultaneous measurement of the tensile force.

Please amend the paragraph beginning on page 4, line 30, as follows:

A testing arrangement suitable for implementing the proposed solution comprises[, as an essential element,] the wire-clamp holder [(which is known per se)] provided with an associated force-measuring element and a control device to control the movement pattern sketched out above, and represents an integrated component of an improved wire bonder.

The paragraph beginning on Page 5, line 18, has been amended as follows:

#### Brief Description of the Drawings

Figure 1 illustrates a schematic drawing of one embodiment of a testing arrangement.

#### Detailed Description of the Preferred Embodiment

Other advantages and useful features of the invention will be apparent from the subordinate claims and from the following description of a preferred exemplary embodiment with reference to [the figure] Figure 1. This shows, in a schematic drawing, a testing

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arrangement 1 with [essential] components of the bonding head 3 of an ultrasonic wire bonder constructed in accordance with the invention. The elementary diagram refers to a bonding head of the kind described in the patent EP 0 857 535 A1, the structural details of which are not shown here. In the nature of a synoptic representation, function blocks are added with evaluation and control functions and symbols for the [essential] procedural steps.

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### IN THE CLAIMS:

Please amend the Claims as follows:

#### WHAT IS CLAIMED IS:

1. (Amended) [Method] A method of testing wire-bond connections between a bonding wire and a separate surface, [which are] the connections being produced by a bonding head with a bonding tool and a wire clamp associated with the bonding tool[,] under pressure and the action of at least one of ultrasound[,] and[/or] heat, the method comprising:

[characterized in that after the bonded connection has been created,] lifting the bonding head or the bonding tool [is lifted] a [short] first distance away from the bonding site, after the bonded connection has been created;

[the bonding wire is] fixedly gripping [gripped by] the bonding wire with the wire clamp;[,] and

raising the bonding head or the wire clamp with bonding wire gripped therein for a second distance[,] during which process the tensile force acting on the bonding wire is detected.

2. (Amended) The [Testing] method [according to] of Claim 1, wherein [characterized in that] raising the bonding head or the wire clamp [is raised] for the [a] second distance is calculated, in dependence on the structural features, so that a predetermined tensile force is exerted as a result of the raising, and an intact state of the bonded connection is detected during raising.

3. (Amended) The [Testing] method of [according to] Claim 2, wherein [characterized in that] the intactness of the bonded connection is determined by observing the time course of the tensile force acting on the wire clamp during the raising.

4. (Amended) A wire [Wire] bonder in which there is integrated into a bonding head a testing arrangement for wire-bond connections between a bonding wire and a separate surface[,in particular a bonding pad].

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5. (Amended) The wire [Wire] bonder of [according to] Claim 4, wherein the [with a] bonding head [that] comprises a tool holder or transducer holder to hold a bonding tool and a wire-clamp holder to hold a wire clamp for gripping [a] the bonding wire, as well as a drive mechanism for [the] vertical displacement of the bonding head or tool holder and wire-clamp holder, and wherein [characterized in that] a program control system to control a predetermined movement sequence of the bonding head or tool holder and the wire-clamp holder is associated with the drive mechanism in order to carry out a measurement of tensile force at the bonding wire, and wherein a force measuring device is associated with the wire-clamp holder in order to measure a tensile force acting on a bonded connection to the bonding wire that has been produced.

6. (Amended) The wire [Wire] bonder of [according to] Claim 5, wherein [characterized in that] the wire-clamp holder is mounted on the bonding head so that it can be elastically deflected [or linearly displaced] against the action of a pretensioning element, and a force-measurement element[, in particular a strain gauge,] is associated with the holder.

7. (Amended) The wire [Wire] bonder of [according to] Claim 6, wherein [characterized in that] the wire-clamp holder comprises a weakened preferential bending section or leaf-spring section, which ensures the elastic deflectability and in which the [strain gauge] force measurement element is located.

8. (Amended) The wire [Wire] bonder of [according to] Claim 5, wherein [characterized in that within] the program control system induces the bonding head to lift a first distance and induces the wire clamp to grip the bonding wire and then induces the bonding head or the wire clamp to raise a second distance while the force measuring device measures the tensile force acting on the bonding wire [a control program for automatically carrying out the method according to one of the claims 1 to 3 is implemented].



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**IN THE ABSTRACT:**

Please amend the abstract as follows:

Abstract of the Disclosure

A method [Method] of testing wire-bond connections between a bonding wire and a substrate surface[, which]. The wire-bond connections are produced by a bonding head with a bonding tool and a wire clamp associated with the bonding tool[,] under pressure and the action of ultrasound and/or heat[,wherein after]. After the bonded connection has been created, the bonding head or the bonding tool is raised a short distance away from the bonding site, the bonding wire is firmly gripped by the wire clamp[,] and the bonding head [or the]. The wire clamp with bonding wire gripped therein is raised for a second distance, during which process the tensile force acting on the bonding wire is detected.

[(Figure)]

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